Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
Amendment of Parts 2 and 97 of the	)	
Commission's Rules Regarding the	)	RM-10165
2300-2305 MHz Band	)	
	)	
Co-Primary Allocation of 2300-2305 MHz	)	
to the Amateur Radio Service and the	)	RM-10166
Miscellaneous Wireless Communications	)	
Service	)	

Reply Comments of AeroAstro

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Reply Comments of AeroAstro

AeroAstro, Inc. files these Reply Comments in response to oppositions filed against AeroAstro's Petition for Rule Making in the above-referenced matter, RM-10166.[1] ARRL, the National Association for Amateur Radio (ARRL), filed a competing Petition relating to the same band, RM-10165, on May 7, 2001.[2]

A. SUMMARY

AeroAstro has proposed co-primary sharing of the 2300-2305 MHz band between the Amateur Radio Service and a low-power commercial service. Several Amateur interests oppose the proposal, preferring to maintain their exclusive occupancy of the band. But the current Amateur allocation is only secondary. The Amateur community has always been on notice that the Commission could add a primary service to the band without diminishing Amateurs' rights. By contrast, AeroAstro's proposal -- co-primary operation under low-power commercial rules -- is minimally disruptive to Amateur operations, and complies with NTIA's recommendations for

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1 *See* Public Notice Report No. 24912 (released July 2, 2001).

2 *See id.*

protection of the adjacent-band Deep Space Network. Because it adds 5 MHz of prime UHF spectrum to the Commission's useful inventory, AeroAstro's proposal is also in the public interest.

B. PARTIES

The following parties filed in docket RM-10166 (AeroAstro's Petition) and served AeroAstro, as required under Section 1.405(a):

Nickolaus E. Leggett
MicroTrax
The National Association for Amateur Radio (ARRL)

The following parties filed in RM-10166 but did not serve AeroAstro. We located their filings on the Commission website and respond to their oppositions below.[3]

Lilburn R. Smith
Al Ward

Finally, the following parties filed in RM-10165 (ARRL's Petition), but took positions that affect the AeroAstro Petition as well. We include them in this response.

Randy Bynum
Erik Dean
Thomas C. Haddon, III
Victor M. Magana
Tim Stoffel

C. ABOUT AEROASTRO

Since its founding in 1988, AeroAstro has focused on lowering the cost of working in space so as to make space activities accessible to a broader community. The company has

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[3] We are unable to serve some of these parties in accordance with Section 1.405(b) because their filings did not include a mailing address. Details appear on the Certificate of Service.

brought space to students at high school through post-graduate level, scientists operating on very limited research budgets, small start-up businesses, and the general public. In doing so, AeroAstro has pioneered new uses of space and spacecraft that are appropriate to our low cost, highly accessible approaches to aerospace engineering. Moreover, some of the spin-off from that work shows promise for terrestrial communications. For more information on AeroAstro's track record, see Appendix A.

AeroAstro is interested in the 2300-2305 MHz band in connection with its plans to implement a satellite-based system called SENS (Satellite Enabled Notification System). SENS will enable users to transmit short data messages from any location on the globe, for receipt via the Internet in near-real-time. The system will use small, low-cost mobile ground terminals to transmit low-power messages to the satellites, which act as bent pipes to relay the data down to the nearest ground receiver station. For more information on this application, see Appendix B.

AeroAstro proposes to use the 2300-2305 MHz band only for uplinks from low-power terrestrial terminals to satellites. No downlinks will be operated in the band.

D. BACKGROUND

The AeroAstro and ARRL petitions make inconsistent requests for allocation of the 2300-2305 MHz band. ARRL seeks an *exclusive* primary allocation to the Amateur Radio Service. AeroAstro, in contrast, seeks a *co-primary* allocation to the Amateur Radio Service and the Miscellaneous Wireless Communications service (MWCS).

AeroAstro has proposed technical rules that will enable the Amateur Radio Service and low-power commercial operations to share the 2300-2305 MHz band on a co-primary basis, without causing harmful interference to each other. These rules also conform to NTIA's

recommendations for protection of the sensitive receivers of the Deep Space Network in the adjacent band at 2390-2300 MHz.

E. GROUNDS FOR OPPOSITION

The chief basis for the Amateur community's opposing AeroAstro's proposal is a concern that co-primary allocation would "result in a significant reduction of the capability of the Amateur Radio Service."[4] As a backdrop to these concerns, ARRL notes that spectrum allocations to the Amateur Radio Service have diminished, particularly in the 2300-2400 MHz band, and expresses concern that a grant of AeroAstro's Petition will continue that process.[5]

ARRL also questions whether AeroAstro's proposed use will be compatible with Amateur operations.[6] Several commenters specifically mention the importance of maintaining a low noise floor in the band for Amateur operations, and state that AeroAstro's proposal would put unacceptable levels of noise into the band, especially with regard to weak signal operations.[7]

Other commenters, somewhat at odds with the first group, object to AeroAstro's proposal because they seek to retain the option of high-power operation in the band.[8]

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[4] Comments of Nickolaus E. Leggett at 1.

[5] *E.g.*, Comments of ARRL at 7-8.

[6] Comments of ARRL at 5-7.

[7] Comments of Thomas C. Haddon, III, Al Ward, Lilburn Smith.

[8] *E.g.*, comments of Nickolaus E. Leggett at 1-2 (citing present 1.5 kW PEP power limit).

Two commenters suggest keeping Amateur-only operation at 2300-2305 MHz as a "guard band" or "buffer" to protect NASA operations below 2300 MHz.[9]

Some commenters object to AeroAstro's proposal on the ground that it would threaten their financial investment in equipment for the band.[10]

Finally, ARRL notes that the Commission has proposed in another docket to allocate another band that might be suitable for AeroAstro's use, and on that basis argues AeroAstro's Petition is untimely.[11]

The only non-Amateur comment comes from MicroTrax, which asks the Commission to allocate 2300-2305 MHz to its Personal Location and Monitoring Service.[12]

F. RESPONSE TO OPPOSITION

AeroAstro acknowledges that Amateur operators prefer to have the 2300-2305 MHz band left to their exclusive use. But that resolution is not in the public interest.

The 2300 MHz Amateur allocation dates back at least to 1940, when there was still plenty of spectrum to go around.[13] In those days single-service allocations were commonplace, not only for the Amateur Radio Service, but for all services. Since then, although engineering advances have pushed back the upper limits of useful frequency, user demand has increased

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[9] Comments of Tim Stoffel, Randy Bynum

[10] Comments of Thomas C. Haddon, III, Randy Bynum, Lilburn Smith.

[11] Comments of ARRL at 8-10.

[12] Comments of MicroTrax.

[13] *See* Aural Broadcasting on Frequencies above 25,000 Kilocycles Particularly Relating to Frequency Modulation, 39 F.C.C. 29 (1940).

faster. A glance at the current allocation table shows that sharing among services has become the rule, not the exception.[14]

In their exhortations against sharing, AeroAstro's opponents overlook a critical detail. The 2300-2305 MHz band is currently allocated to the Amateur Radio Service *on a secondary basis*. The Commission could, hypothetically, introduce a primary service into the band without "taking away" any rights the Amateurs presently enjoy -- even though Amateur operators would then have to accept interference from the primary service, and would be constrained not to interfere with it. A secondary allocation is tantamount to notice that an incoming primary allocation might cramp one's operations. The Amateur community's interest in avoiding a co-allocation is understandable, but its standing is weak.

In any event, AeroAstro does *not* seek to impose a primary allocation with rights superior to those of the Amateurs. Rather, we suggest a co-primary allocation in which Amateur and commercial users have equal rights. Moreover, we propose technical rules calculated to keep mutual interference to a minimum, while allowing Amateurs to continue their present operations and still make room for a useful commercial service.

Public interest. AeroAstro understands that its proposals are less attractive to the Amateur community than continued sole occupancy of the band. In light of the worsening spectrum shortage, however, the public interest favors shared use of the band. The Amateurs opposing AeroAstro have eloquently expressed their *own* interest in maintaining the status quo. But they have not explained why doing so is in the public interest.

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[14] *See* 47 C.F.R. Sec. 2.106.

Guard band. The argument that Amateur occupancy forms a protective guard band for NASA operations below 2300 MHz makes little sense, in light of AeroAstro's technical proposals. AeroAstro's suggested commercial power limits not only comply with NTIA's recommendations for the band,[15] but allow far less power than current Amateur operations -- and several orders of magnitude less power than the Amateur rules permit. In short, AeroAstro's proposal is less of a threat to the Deep Space Network than Amateur use.

Protection of investment. In keeping with long-standing policy, the Commission should disregard allegations that re-allocating the band will threaten investments in equipment. Anyone making such investments in a secondary allocation does so at his or her own risk.

Technical objections. AeroAstro has already answered some of ARRL's challenges to its technical proposal. First, ARRL states it is "not aware" that NTIA requested technical parameters similar to AeroAstro's proposal.[16] AeroAstro's Petition for Rulemaking described NTIA's request in detail, and provided citations.[17] Second, ARRL states that AeroAstro's proposal does not describe Part 15 level devices.[18] AeroAstro specifically proposed that the Commission apply the technical rules in Section 15.247 (except for operating frequency) to

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[15] U.S. Department of Commerce, *Spectrum Reallocation Final Report, Response to Title VI - Omnibus Budget Reconciliation Act of 1993,* at Section 4 (NTIA Special Publication 95-32, Feb. 1995).

[16] Comments of ARRL at 4.

[17] *See* Petition for Rulemaking of AeroAstro, Inc., RM-10165 at 8-9 (filed April 9, 2001) (AeroAstro Petition).

[18] Comments of ARRL at 4.

commercial service at 2300-2305 MHz.[19] Third, ARRL notes the Commission recently proposed to modify Section 15.247, and fears that devices complying with the amended rules might offer less interference protection to Amateur receivers.[20] AeroAstro disputes that the proposed changes would create more interference for Amateur operators. But the issue is moot, because AeroAstro stated in its comments, filed two weeks ago,

> We propose that the Commission accept any spread spectrum modulation that complies with the present (August 2001) version of Section 15.247 (except for operating frequency). Alternative "digital modulations" recently advanced by the Commission would not be acceptable.[21]

ARRL also contends that AeroAstro's proposal "is preclusive of most Amateur operation currently in the band."[22] Our information on current Amateur operations is derived from NTIA publications and ARRL's own filings.[23] Nevertheless, AeroAstro is willing to entertain good-faith discussions of changes to its proposed Amateur technical rules aimed at promoting non-interfering operations between the two services.

Other dockets. Finally, the fact that the Commission mentioned AeroAstro in another docket dealing with a different band has nothing to do with this proceeding. AeroAstro is not asking that 2300-2305 MHz be designated specifically for its own use. AeroAstro asserts, rather, that it would serve the public interest to allocate the band on a co-primary basis to a

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19 AeroAstro Petition at 12 n.26.

20 Comments of ARRL at 5.

21 Comments of AeroAstro at 5, n.10 (filed Aug. 1, 2001).

22 Comments of ARRL at 6-7.

23 *See* AeroAstro Petition at 6-8.

commercial service, under technical rules compatible with both Amateur operation and protection of the Deep Space Network. AeroAstro offers its own technology as an "existence proof" that such commercial operation is practicable. But we expect steep competition for access not only to 2300-2305 MHz, but also to other bands now under consideration.

MicroTrax. MicroTrax is one example of another technology likely to compete for spectrum with AeroAstro. We see no reason why the Commission should allocate the band *a priori* to MicroTrax's service, any more than it should to AeroAstro's. Rather, the Commission should establish suitable technical and service rules, and let the market decide what services should be offered.

G. CONCLUSION

A co-primary allocation to the Amateur Radio Service and commercial use, under appropriate technical rules, benefits everyone. NASA will be assured of continued protection to the Deep Space Network. The Amateurs will achieve primary status, albeit shared. AeroAstro (or whoever wins the auction) will be able to serve its customers. And the Commission will have put under-utilized spectrum into full commercial service.

Respectfully submitted,

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August 15, 2001

Appendix A --About AeroAstro

Since its founding in 1988, AeroAstro has focused exclusively on lowering the cost of working in space so as to make space activities accessible to a broader community. The company has brought space to students at high school through post-graduate level, scientists operating on very limited research budgets, small start-up businesses, and the general public. In doing so, AeroAstro has pioneered new uses of space and spacecraft that are appropriate to our low cost, highly accessible approaches to aerospace engineering.

AeroAstro's first satellite, ALEXIS, is a small spacecraft developed for the Los Alamos National Laboratory to provide high resolution maps of low-energy x-ray sources and ionospheric physics. AeroAstro designed and built the spacecraft bus and the ground station, and also supported the launch and ground operations activities. ALEXIS was launched in April 1993 and is still operational over six years later, far exceeding its design lifetime of six months.

HETE (High Energy Transient Experiment) is a small satellite developed at AeroAstro for the Massachusetts Institute of Technology. Its mission is detection and observation of high energy events in the gamma ray, X-ray, and UV spectra. AeroAstro provided the spacecraft bus, ground stations, and all payload integration and tests. HETE was launched but lost due to a Pegasus XL failure on November 4, 1996.

TERRIERS (Tomographic Experiment using Radiative Recombinative Ionospheric Extreme Ultraviolet and Radio Sources) is AeroAstro's most recently completed satellite, developed at AeroAstro for Boston University. Its mission is to demonstrate global ionospheric tomography and to utilize this technique for the study of ionospheric/ thermospheric processes.

AeroAstro provided the spacecraft bus, ground stations, and all payload integration and tests. TERRIERS launched successfully in May 1999.

AeroAstro built the S-band spacecraft radios and S-band tracking ground stations for each of the three spacecraft described above, and developed internally all of the software for both the spacecraft and ground stations. In addition, AeroAstro recently built a set of S-band radios for the Swedish FREJA spacecraft, which have been functioning in orbit for more than 6 months.

In 1997, AeroAstro completed the system architecture and design for a LEO spacecraft-based messaging system for an Australia-based firm, KITComm. This system shares some design features with the proposed SENS system, although it is substantially more complex.

Through the NASA Small Business Innovation Research (SBIR) program, AeroAstro is developing compact, power-efficient, inexpensive X-band radios for nanosatellites. The initial design phase has been completed and prototyping is beginning, with an ultimate objective of developing a product suitable for commercialization. These X-band transponders were also recently selected to provide Earth/Space communications for the NASA New Millennium Program's ST5 mission. This mission, the Nanosatellite Constellation Trailblazer, will provide validation of innovative, new technologies for future space missions.

Under a U.S. Air Force contract, AeroAstro is also developing a compact, inexpensive X-band inter-satellite communications and ranging system, to be used on an Air Force nanosatellite constellation mission known as Techsat-21. This system will launched in approximately 2004. This technology is key to both the Air Force and NASA's plans for using constellations of miniature spacecraft as virtual antennas and/or interferometers.

AeroAstro has performed dozens of system designs and studies for organizations including Jet Propulsion Laboratory, Los Alamos National Laboratory, Naval Research Laboratory, NEC, Canadian Space Agency, NASA, Nissan, Philips Labs, and numerous U.S. universities. The company has also developed numerous spacecraft system components for these clients, including sun sensors, NiCad and Li-Ion batteries, mass memories, processor boards, power controllers, cold gas thrusters, electromagnetic torquers, and attitude control software.

Appendix B -- About SENS

AeroAstro's Satellite Enabled Notification System (SENS), now under active development, enables users to transmit short data messages from any location on the globe, for receipt via the Internet in near-real-time. The system has three key components: (a) small, low-cost mobile ground terminals, (b) small, low-cost space stations, and (c) fixed ground receiver stations. The mobile terminals transmit low-power, spread-spectrum modulated messages to the satellites, which act as bent pipes to relay the data down to the nearest ground receiver station.

SENS will use the 2300-2305MHz band only for uplinks from mobile terminals to satellites. No downlinks will be operated in the band.

SENS can also be operated in a terrestrial mode, for applications that are confined to an area of a few kilometers. Instead of a satellite, this implementation uses a tower-mounted receiver with line-of-sight to the active terminals. One early application of this type will use SENS terminals to monitor aircraft noise at locations around an airport, under an experimental license. Similar terminals can be used for both terrestrial and satellite applications, if the same frequency band is available for both.

SENS mobile terminals are direct sequence spread spectrum transmitters, operating at one watt or less, in full compliance with Section 15.247 (except for choice of band). These have the lowest cost, complexity, size, and weight, and require the least supporting infrastructure, of any space-based communications system to date. In commercial quantities, the terminals will cost only a few dollars each to manufacture. A global quasi-real-time service will need only two

small launches of clusters of very low cost microsatellites. Thus, both the user's terminal and access costs will be very low.

Small size and minimal cost will enable SENS to provide critical services not presently available. Using inexpensive GPS technology, SENS can report basic position as well as status data on millions of deployed, highly miniaturized, autonomous terminals. These will eventually be small enough to build into a wristwatch, a bracelet, or a shoe. Early users of SENS terminals will include hikers, hunters, surveyors, and others whose occupation or pastime puts them at risk in the outdoors. Anywhere in the United States, and eventually the world, the push of a button will provide an alert and position fix. In some applications, units will transmit automatically at fixed time intervals or in response to specified external events. SENS terminals may ultimately become a standard feature in children's shoes, military ID bracelets, and even clothing of people who travel or recreate in wilderness areas. Their families and associates can receive frequent updates via the Internet on the traveler's status and position, with histories over time.

SENS can be used to enhance personal safety and security. Older and infirm persons can use SENS to call for assistance. Children can have SENS terminals clipped to their clothing at amusement parks and similar sites where there is a risk of becoming separated from caregivers. Motorists stranded in isolated areas can summon help. Anyone can use SENS as a personal security device, possibly dangling from a key chain.

The tiny, low-cost, low-power SENS uplink terminal can be attached to packages, utility poles, cattle, fleet vehicles, railroad cars, and other deployed capital assets to monitor their positions and conditions. Trucking companies can gather data on speed, mileage, even engine temperature. Soft-drink and other vending machines can report low-stock conditions. The

terminals are so low in cost and small in size that they can be distributed over an agricultural area to monitor water, fertilizer, and pesticide concentrations, along a border crossing to monitor immigration, at building doors and windows to report intruders, or on smoke, heat, and flood alarms for remote monitoring.

In short, SENS combines personal security, asset and resource management, communications, and remote sensing applications in a communications network. It will be a pathfinder for new services, a first point of entry for many clients into wireless and satellite-based services, and a catalyst for other similar systems. Once the system is in place, users no doubt will identify dozens of other applications.

Technical information. Using direct sequence spread spectrum, very low power, and a very high gain satellite-based receiving antenna, SENS emissions are highly spectrum efficient and non-interfering. Except for choice of band, SENS transmitters comply with the Commission's technical requirements for spread spectrum devices. *See* 47 C.F.R. Sec. 15.247. Like other spread spectrum applications, SENS signals can share spectrum with narrowband or other spread spectrum signals with little risk of harmful interference. Terminal data message length is restricted to 128 bits. Data rate will be 100 bits/second, for a transmission time per message of 1.28 seconds. Terminals can be programmed to transmit 2-3 messages in a 24 hour period, as well as to transmit on command from an attached sensor (to report a button press or an alarm condition). Output RF power from a terminal will be approximately -33 dBm/Hz. Low power output makes the terminals safe in any application.

CERTIFICATE OF SERVICE

I, Deborah N. Lunt, a secretary with the law firm of Fletcher, Heald & Hildreth, P.L.C., hereby state that I forwarded the forgoing Comments of AeroAstro, Inc., by first-class mail, postage prepaid, this 16th day of August, 2001, to the following:

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